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COMPUTER ART: A NEW AGENDA FOR INFORMATION SYSTEMS RESEARCH

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Abstract

This paper proposes a new agenda for information systems research: computer art. It explains why computer art might be seen as a kind of information system, and proposes an agenda for IS research that is based upon six themes in computer art and related work in previous IS research. Twelve research questions are suggested. The link between IS and computer art is bidirectional: our theories of information systems could inform the study of computer art, and computer art could inform our information systems theories. Possible barriers to IS researchers studying computer art are also discussed. The paper makes an important contribution by suggesting new opportunities for innovative research in IS and by signposting some of the topics that could be addressed.

Keywords: Computer art, digital art, visual aesthetics, information behaviors

Introduction

Information systems research is concerned with the development and use of information systems by individuals, organizations, and society. Usually these information systems are based on information technology. There has been discussion in the literature about the scope of the IS discipline and IS research (e.g., Benbasat and Zmud 2003; Orlikowski and Iacono 2001; Weber 2003). Some want to draw boundaries around the subject to define what is or is not IS, but this seems somewhat premature, since the potential applications and effects of IT-based systems in different contexts are not fully known and are continuing to evolve (see also Westland 2004). Instead this paper proposes *widening* the scope of IS research, to include a new area for study: computer art. There is a considerable body of literature on computer art and many computer artworks, but they have received little attention so far in IS research.

This paper argues that computer art *should* be included within the scope of the IS discipline. It does not report on completed research but takes the form of a reflective essay. It reviews themes in computer art, with illustrative examples from computer artists, and links these themes to existing research strands in IS, in order to suggest that current and new IS theories be explored within a different domain. It suggests that computer art and IS could each inform the other, that is, the link between IS and computer art is bidirectional: our theories of information systems could inform the study of computer art, and computer art could inform our information systems theories. A new agenda for IS research, based upon 6 themes and 12 research questions is proposed. These questions are intended as signposts for IS researchers, to indicate a potential direction of travel, without, at this stage, being certain of the final destination. Some of the suggested avenues may turn out to be *cul-de-sacs*, blind alleys leading nowhere, but some of them may lead to revised or new theories about the nature of information systems development and use. Possible barriers to IS researchers studying computer art and addressing the suggested questions are also discussed. The paper makes an important contribution by suggesting new opportunities for innovative research in IS and by signposting some of the topics that could be addressed.

Computer Art

Computer art is concerned with artworks that “were impossible to produce before the invention of the computer...even unimaginable” (Weibel 1992). Other terms include *software art*, *net art*, *new media art*, and *cyber art*. It involves the use of information technology to inform, explore, question, or illuminate. Artists work with both static and dynamic computer-based images, animations, and multimedia to offer interpretations and construct meaning. Digital technology also offers new possibilities for artists to explore beyond those offered by conventional art media, including interactivity, participation, a dynamic nature, and customizability (Paul 2003).

Users or stakeholders of computer art include art critics, art historians, gallery owners, museum curators, and anyone who likes to purchase or view pieces of contemporary art. In addition, in a world increasingly dominated by the visual and the computer (Manovich 2001a), most people, in the developed world at least, are users of digital images. Digital art underlies all types of the new media (Manovich 2001a, pp. 8-9): “Web sites, virtual worlds, virtual reality (VR), multimedia, computer games, interactive installations, computer animation, digital video, cinema, and human-computer interaction.”

A reviewer of this paper asked whether it is concerned with computer art as a fine or applied art. By convention, *fine arts* (e.g., painting, sculpture) refers to artefacts produced chiefly for aesthetic value or intellectual stimulation to the viewer, whereas *applied arts* (e.g., architecture, textiles) refers to the application of design and aesthetics for practical use. However, modern art commentators recognize both the multitude of media in which art now occurs, so that this simple distinction no longer applies, and that all art can have a use of some kind (e.g., as a means of expression, to boost morale, to pass ideas and concepts on to later generations, etc.). The fine or applied art distinction is no longer helpful. This paper is concerned with computer art whether perceived as fine or applied, but from the perspective of an IS researcher.

The use of computers and digital technology for the production of artworks can be traced back to the 1960s, with, for example, an exhibition of computer graphics in art by Georg Nees in 1965, the founding of the interdisciplinary art, science, and technology journal *Leonardo* in 1967, and the establishment of the Computer Arts Society in 1969. The increasing availability and reduction in costs of hardware and software, the spread of the Internet and World Wide Web, and the popularity of computer-generated animations and games have all contributed to growing interest in computer art. (For useful overviews of the history of digital art, see Candy and Edmonds 2002; Greene 2004; Paul 2003).

Some argue that it has not yet reached maturity as an art form. For example, Robert Fitzpatrick, director of Chicago’s Museum of Contemporary Art, argues that computer art is a potentially powerful but still embryonic medium, likening it to the evolution of photography in the 19th century. “Photography began by simply capturing a building or a person, and it took decades for artists to develop the medium as a brilliant, original art form” (Loring 2001). Although he believes that some computer art techniques, such as virtual reality, have artistic potential, “right now the technology is primarily being used for Sony PlayStations and things like that; artistically it has not reached a level of meaningful content yet” (Loring 2001).

However, others maintain computer art is already having a profound impact on artistic expression:

Over the past decade the world of contemporary art has experienced the beginnings of a tectonic shift. Digital technology has arrived as a component of everyday life and contemporary art on a global scale....Artists are adopting new technologies in the studio, deploying them in the gallery, inhabiting them through the Internet, and making artwork that reflects our technology-saturated society in a stunning range of ways (Catalogue for 010101: Art in Technological Times, an exhibition at the San Francisco Museum of Modern Art 2001).

Whether or not art critics accept computer art as a mature art form, it is an interesting application of information technology, which could be studied by IS researchers, as the next section explains.

An Agenda for Information Systems Research into Computer Art

This section reviews 6 themes in computer art and relates them to research, either existing or potential, in IS, leading to the setting of 12 questions as an agenda for IS research into computer art (see Table 1).

Table 1. An Agenda for Information Systems Research into Computer Art

Theme	Research Questions
1. Computer art as an information system	Can our understanding of information systems be applied to the domain of computer art?
	How does an understanding of computer art lead to a reappraisal of our understanding of information systems?
2. Computer art and the commercial perspective	How can our understanding of the management and commercial aspects of information systems be applied to computer art?
	How can an understanding of computer art be applied to the management and commercial aspects of information systems?
3. Visual aesthetics	How can an understanding of visual aesthetics inform the analysis, design, use, and evaluation of information systems?
	How can IS researchers' knowledge of information behaviors and IS development contribute to the understanding of computer art?
4. Computer art as a socio-technical system	Can we apply our theories about the socio-technical nature of information systems development and use to computer art?
	How does an understanding of computer art lead to a reappraisal of our understanding of the socio-technical nature of systems development and use?
5. A turn to the visual	How can our interpretive theories explain the use of the visual in computer artefacts?
	How does an understanding of computer art lead to a reappraisal of our interpretive theories?
6. Challenging assumptions and conventions	What assumptions about the nature of our modern information systems-supported world does computer art expose or illuminate?
	What cultural conventions and implicit assumptions can IS researchers discover in computer artists and their works?

Theme 1: Computer Art as an Information System

We start by suggesting that computer art might be seen as a kind of information system. This may require a leap of imagination for some in the IS community. An information system is conventionally seen as an input–process–output system, created by systems developers, within a particular organizational context, and incorporating many different components: people, organizations, data or information, and the procedures and methods to collect, manipulate, modify, transmit, distribute, store, and retrieve information. People read and interpret the data provided by the system, so that data becomes information through their perception of it and their application of meaning. How can a computer artwork map onto this definition?

There *are* similarities. Computer artworks are created by artists, within a particular organizational context. Many receive data inputs, process it in some way (manipulate, modify, etc.) and output some results. The kind of output may differ: conventional information systems' outputs are often in a textual form, whereas computer artworks often take a visual form. But the visual is still a form of information. Audiences perceive these images and apply meaning to what they see, either the meaning intended by the artist or a different one, so that, as with conventional information systems, data becomes information through people's perception of it and their application of meaning.

Some computer artworks communicate with, and make use of, the types of information systems IS researchers are more accustomed to studying. For example, two pieces help make the workings of the stock market visible:

- Lynn Hershman's *Synthia* (2001) shows a virtual character whose actions are related to the stock market fluctuations (if the market goes up, she dances, if it goes down she chain smokes, and so on) (<http://framework.v2.nl/archive/archive/node/work/all.xslt/nodenr-146414>).

- Autogena and Portway's *Black Shoals Stock Market Planetarium* (2001) visualises the stock market as a star chart, with stars/stocks glowing brighter or dimmer depending on the trading volume, and drifting together or apart depending on the congruence of their trading histories (<http://www.stain.org/shoals/html/frontpage.html>).

Hence one IT-based system (an artwork) is linked to another (the stock market). Why should IS researchers study the development and use of the latter, but not the former?

Other computer artworks may not involve dynamic data processing, so do not map as well onto the conventional input-process-output view of an information system. However, nor do many modern uses of IT already accepted by researchers as within the IS domain. For example, static websites (those without any transaction processing) and blogs (on-line diaries) are created by people for an audience to tell a particular story—just like computer artworks; the former are already studied by IS researchers, why not the latter?

It is probably futile to argue further whether or not computer art *is* an information system. Instead this paper suggests that we explore the implications of taking that leap of imagination by treating computer art *as if it were* an information system. This is similar to the shift introduced by soft systems methodology (SSM) (Checkland 1981; Checkland and Scholes 1990): users of SSM moved from saying some aspect of the world *was* a system to treating it *as if it were* a system. Our concern would not be to appreciate computer art on its own terms, but to examine its development, performance, interpretation, and use from the perspective of IS.

If some IS researchers are prepared to accept that computer art might be seen as a kind of information system, we arrive at the first of our research questions: to ask whether and how our current knowledge about information systems, developed over the past 30 or so years, can be applied to the domain of computer art.

- **Research Question: Can our understanding of information systems be applied to the domain of computer art?**

This question also has a converse. Computer artworks do not just have an *informational dimension* (the experience of viewing and interacting with them through retrieving, looking at and thinking about quantified—i.e., digitized—data); they also have experiential and aesthetic dimensions. These justify their status as art and not just information design, including particular configurations of space, time and surface, user activities and interaction over time, and a phenomenological user experience (Manovich 2001a, p. 66). However, all interactions between a user and a computer system include particular configurations and a phenomenological user experience, but they have not been well-addressed by IS researchers. Perhaps by studying computer art and its additional dimensions, we may be forced to modify our understanding of what we mean by an information system.

- **Research Question: How does an understanding of computer art lead to a reappraisal of our understanding of information systems?**

Theme 2: Computer Art and the Commercial Perspective

Many IS researchers choose to focus on the use of IT by business organizations. They should not, however, ignore computer art, since it does have a commercial perspective. The creative industries, which of course include the creation of computer artefacts, are increasingly being seen by governments as an important sector in their nation's economy. For example, the UK government's website (http://www.culture.gov.uk/creative_industries/default.htm) claims that exports by the creative industries contributed £11.4 billion to the UK's balance of trade in 2001, which equates to around 4.2 percent of all goods and services exported. With their understanding of the underlying information technology, IS researchers are well-placed to investigate *how* the digital creative industries contribute to the wealth or welfare of a nation.

For IS researchers interested in sales and marketing, information economics, database systems, legacy systems, or computer law, their concerns and theories could also apply to the management of computer art. For example, how do artists find buyers? How do buyers use or appreciate computer art? How can one buy and sell computer art? How can museums and galleries curate computer art? How can a work of art created for the Internet be preserved when browsers are frequently updated and websites evolve or disappear? How can copyright of computer art be protected?

Hence a research question:

- **Research Question: How can our understanding of the management and commercial aspects of information systems be applied to computer art?**

And again, we can look at this topic from the opposite direction:

- **Research Question: How can an understanding of computer art be applied to the management and commercial aspects of information systems?**

For example, many computer artists work in the commercial world in order to earn money to survive, perhaps as website designers, and many digital content creators perceive themselves as artists rather than technologists. In the past, IS researchers have examined the worldviews and practices of technically oriented IT developers. Now it is also necessary to understand the worldviews and creative cognitive processes of artistically oriented personnel. Some research has already been undertaken. The Creativity and Cognition Research Studios at Loughborough University, for example, has hosted a number of artist-in-residence projects where artists and computer technologists have collaborated on artworks (Candy and Edmonds 2002). Researchers have observed the interactions between technologists and artists, and attempted to understand the creative process. However, this research is studio-based, where the primary focus is on exploring the artistic possibilities of digital technology. Which aspects of computer art practice can be transferred to commercial development projects? What happens when artists and technically oriented personnel must collaborate on a commercial project, within a context of time and budget pressures and office politics? And do artistically oriented personnel bring different practices and require different incentives than technically oriented developers?

Artists have also worked in creative partnerships with private companies and schools, and with professionals such as doctors, scientists, and architects. Artists in such partnerships can challenge stereotypes, change attitudes, and enable seeing in new ways. IS researchers could explore how artists and computer art enable such re-conceptualizations.

Finally, most modern information systems include a visual element to their interfaces or websites, involving windows, radio buttons, background logos, etc., and often, especially in web-based applications, incorporating graphics, video clips, and animations. It is vital that IS researchers, developers, and business organizations understand how the visual conveys meaning, otherwise they might find that a competitor's website (or other software artefact) is more successful than theirs, and they cannot tell why. This topic is developed further under the next theme.

Theme 3: Visual Aesthetics

IS researchers and practitioners have developed a set of criteria for analyzing and evaluating the technical aspects of software artefacts, such as reliability and maintainability (see Pressman 2004). They have also developed criteria and models for assessing the social aspects of an information system including

- The technology acceptance model (Davis 1989) and various extensions to it
- Contribution to the efficiency and effectiveness of business organizations
- Contribution to e-democracy and e-government
- Role in increasing or decreasing the power of certain groups
- Ability to promote the Habermas ideal of rational discourse

However, as noted above, many modern information systems also have a visual aspect as well. In order to analyze fully and to evaluate modern information systems, it is necessary to understand visual aesthetics. IS researchers need to understand how aesthetics can make a digital artefact (such as a website) stand out in a crowded marketplace, generate emotions in users, or help satisfy basic human needs (Tractinsky 2004). This gap has not been addressed by HCI (human-computer interaction) researchers; they have focused on the technical and cognitive psychology aspects of interactive computer artefacts, not on cultural and aesthetic levels of analysis (Bertelsen and Pold 2004; Tractinsky 2004). Artists and art critics have developed a set of visual aesthetics criteria over hundreds, even thousands, of years. IS researchers now need to understand and apply these criteria to computer artefacts. The study of the visual aesthetics of such artefacts could include

- Stylistic references and genres in the interface, the representational techniques employed (e.g., realistic and naturalistic versus symbolic and allegorical representation), materiality (the constituents of the interface, such as code, algorithms, pixels), and remediation (how the interface draws on other media, such as text pages, photography, cinematic language and control panels) (Bertelsen and Pold 2004, p. 26).

- The use of figure or ground relationships, interruption, proximity, similarity, continuation, and closure, the upright and horizontal, balance and symmetry, repetition, rhythm and pattern, color, texture and contrast—and the association of each of these with dynamic interaction and functionality (Finnegan and Griffin 2000).

By understanding visual aesthetics, IS researchers could help practitioners develop more effective or pleasing information systems. They could also learn how to employ ideas like those in *Black Shoals Stock Market Planetarium*, for example (see earlier), to help organizations find new ways of visualizing and hence interpreting their data and making more effective use of their information.

Such an understanding of visual aesthetics will also need to be incorporated into the education of future IS developers. As Manovich (2003, p. 363) argues,

Computer scientists working on media computing play the key role in how our societies will remember their histories, how we will represent ourselves and others, what we will imagine and what metaphors we use to understand reality....Unfortunately, more often than not, computer scientists do not take advantage of their powers. Too often, they simply translate existing media forms and cultural techniques into software interfaces.

Thus another research question:

- **Research Question: How can an understanding of visual aesthetics inform the analysis, design, use, and evaluation of information systems?**

Again there is a converse. As noted above, many computer artworks also have an informational dimension where users or viewers retrieve, look at, and think about digitized data (Manovich 2001a, p. 66). In order to understand fully the digital aesthetics of computer art, we need to understand these information behaviors (Manovich 2001b). Indeed it has been argued that not just computer art but the whole history of art can and should be reconceptualized as “not only about the stylistic innovation, the struggle to represent reality, human fate, the relationship between society and the individual, etc.—it is also *the history of new information interfaces developed by artists, and the new information behaviors developed by users*” (Manovich 2001b, emphasis in original). IS researchers are ideally placed to bring a knowledge of information interfaces and information behavior to the study of computer artworks—even art in general. They can also bring their understanding of how information systems are developed to analyze how computer artists develop their artefacts. This gives us the question:

- **Research Question: How can IS researchers’ knowledge of information behaviors and IS development contribute to the understanding of computer art?**

Theme 4: Computer Art as a Socio-Technical System

An important theme in much computer art is interactivity: the viewer or user is not passive but acts or manipulates something (e.g., a mouse) in order to experience fully the artwork. It can be argued that all art is interactive in that the user is required to do work: supply missing details and understand shortcuts in pictures, move around sculpture and architecture to appreciate the spatial structure, focus on different parts of a stage in a drama performance, etc. (Manovich 2001a, p. 56). However, computer art places more cognitive and physical demands on the viewer or user. Often it requires that people *do* something if it is to be seen in the way the artist intended. People do not just act in order to experience and interpret the work but also must act in order to help *create* the work. Forms of interactivity by individuals or groups which can cause a computer artwork to “perform” include physical presence in a room, gesture and physical movement such as dance, making a sound and carrying out drawing-like activities (e.g., by using a mouse) (Lansdown 2002, p. 56). Such actions can lead to changing the order of display of images, and modifying content, color, or form. Control over content, context, and time can thus be transferred from the artist to the audience (Paul 2003). For example,

- Jeffrey Shaw’s *The Legible City* (1988-91) involves the user sitting on a (fixed-down) bicycle (http://www.jeffrey-shaw.net/html_main/frameset-works.php3). A computer translates the physical movements of the pedals and handle bars to change the user’s view and enable apparent navigation of a “city,” made up of computer-generated three-dimensional letters that represent buildings. As the “cyclist” navigates, words and stories are formed from the letters/buildings. “Bicycling through this city is a journey of reading, choosing a direction is a choice of text and meaning” (Rieser 2002, p. 83).
- Char Davies’ *Osmose* (1995) (<http://www.immersence.com/>) allows the participant to explore a virtual world. Breathing in enables him/her to rise, breathing out to descend, moving forward or backward enables corresponding movements in the virtual world. An audience can witness the journey on a large projection screen.

Such interactive computer artworks rely on people to make them complete and to function (just as conventional information systems do); they can be seen as a kind of *socio-technical system*. The IS discipline has a long history of seeing information systems as socio-technical systems. Indeed it is this perspective that best differentiates it from the computer science discipline. However, IS researchers have usually studied socio-technical systems within a business context; now they could also examine socio-technical systems within a digital art studio or gallery context. Through such study, they might discover whether and how audience participation in an interactive computer artwork is different from the socio-technical characteristics of conventional information systems.

Some computer artists choose to work with others—over the Web, through community classes, youth after-school programs, and artist residencies—to create new artworks. Hence the *development* of the artwork is a joint and collaborative process. For example: Douglas Davis' *The World's First Collaborative Sentence* (1994) (<http://ca80.lehman.cuny.edu/davis/>) was one of the first Internet artworks. Anyone can add to the sentence, providing they do not finish it by adding a full-stop. Its development over the years reflects the evolution of the Web and also reflects the nature of Net discourse, “with its fractious rants, self-advertisements and myriad minor obsessions, its links to homepages and porn sites, its many dead links, and in being the victim of vandalistic hacks (including, of course, the addition of full stops)” (Stallabrass 2003, pp. 60-61).

IS researchers have long argued for user participation in the creation of information systems (e.g., Bjercknes et al. 1987; Ehn and Kyng 1987). Here, then, is an example of such user participation. We could ask whether our current understanding of participation in systems development applies equally to the creation of computer artistic works. There has also been increasing interest in IS in the open source movement (e.g., Feller and Fitzgerald 2001), where software is developed collaboratively. Can our knowledge and theories about this movement be applied to work such as *The World's First Collaborative Sentence*?

- **Research Question: Can we apply our theories about the socio-technical nature of information systems development and use to computer art?**

Again the question has a converse: whether studying the design and use of computer art as a socio-technical process forces us to change our social-technical theories. For example, collaboration and participation in the creation of computer art raises questions about ownership, authorship, and ideas of function and value, some of which members of the open source movement and information economists are also tackling. Could these questions also be raised about more conventional, single-business information systems?

- **Research Question: How does an understanding of computer art lead to a reappraisal of our understanding of the socio-technical nature of systems development and use?**

Theme 5: A Turn to the Visual

The increasing adoption of interpretivism rather than positivism (Avison 1997; Walsham 1995) is a manifestation in IS of a phenomenon that took place last century across the social sciences (Oates 2004): a change of paradigm, in what has been called the *linguistic turn*. This brought the realization that there is a difference between the world itself and our interpreted experience of the world. Researchers began to look at the previously little-explored role of language in our construction of our world. It was recognized that whatever reality is, it can only be accessed through social constructions such as language and shared meanings and understanding. Interpretive studies examine people in their social settings and try to understand phenomena through the meanings that people assign to them. The aim is “an organized discovery of how human agents make sense of their perceived worlds, and how those perceptions change over time and differ from one person or group to another” (Checkland and Holwell 1998, p. 22).

However, we do not create meanings and develop shared understanding only through words. We also use images, models, and diagrams (for example, webpages, UML class diagrams, rich pictures, sketches on the back of an envelope). To discover fully how people perceive and construct their worlds, we need to understand how they use visual artefacts.

With their emphasis on the social and not just technical nature of information systems, IS researches have tended to use the research methods of the social sciences. Here, however, most researchers concentrate on the words people use in documents, observed interactions, questionnaire responses, and interview dialogues. Comparatively few social science, or IS, researchers use images as a source of data to understand people and their worlds. Of those that do, images such as photographs have been used mostly to support or illustrate the analysis of textual data, rather than as an independent source of data, and have typically

been seen as an objective representation of *reality* rather than an artefact created by people to convey particular messages (see Prior 2004; Prosser 1998; Rose 2001).

There have therefore been calls for another turn in qualitative, interpretive research, this time to the visual (Prosser 1998; Rose 2001). This goes beyond the aesthetics of the visual (discussed under theme 3), to explore how people use the visual, alongside or instead of the verbal or textual, to interpret and make sense of their perceived worlds. As noted earlier, most modern information systems use visual artefacts as well as words to convey meaning: icons, windows, drop-down menus, scrollbars, embedded images, video files, and animations. To understand how people develop and use such systems, it is vital to include knowledge of how the visual is used in meaning creation. For example, some research has looked at how individuals use personal webpages as a form of identity construction, but there has been little study of how organizations use their websites in a similar manner (Hine 2001); there has been study of how design engineers have a visual culture (Henderson 1999), but not how IS developers use the visual. Computer artists have a highly developed understanding of the visual. By studying what they do, we could understand more about the visual dimension in meaning creation. This might also require a change to our current interpretive theories.

This leads us to another research question and its converse:

- **Research Question: How can our interpretive theories explain the use of the visual in computer artefacts?**
- **Research Question: How does an understanding of computer art lead to a reappraisal of our interpretive theories?**

Theme 6: Challenging Assumptions and Conventions

One feature of artworks, including computer art, is that they can expose the familiar in a new light, forcing us to recognize and reassess taken-for-granted assumptions and cultural conventions. Many computer artists create works that expose and question aspects of our information systems-supported world.

For example, Tomoko Takahashi's *Word Perfect* (2000) looks like a word processing program, with which most IS researchers are familiar (<http://www.e-2.org/perfect/frame.html>). However, although it does function as a word processor, *Word Perfect* questions the norms of writing using a computer program. For example,

- Instead of the usual templates (e.g., report, memo, letter, etc.), *Word Perfect* offers us such things as a bus ticket or piece of cardboard to write on.
- Instead of the usual fonts (e.g., Times Roman, Arial, etc.) the user can choose that the text be messy, tidy or barely visible.
- Hitting the “undo” key produces the message “Once you written [sic] you can’t take it back. Be responsible whatever you’ve done!!”

This piece makes us conscious of the conventions of modern computer-supported writing.

Other computer artists have enabled us to view differently the Web and how we use it. For example,

- The group I/O/D created *Web Stalker* (1997) (www.backspace.org/iod). When you type in a URL for a website, it displays all the webpages that link to that URL via line graphs that look like spiders' webs, thus making visible the network of information that makes up the Web.
- Brucker-Cohen's *Crank the Web* (2001) is a web browser where the user must turn a handle for it to function. It thus physically grounds the Internet, which is often discussed without any reference to the labors (computer manufacturing, software programming) that make it possible (Greene 2004, p. 86).

Much of our modern world is based upon the use of information systems and information technology. Some computer artworks help to show us the cultural conventions and taken-for-granted assumptions concerning IT that permeate much of our society, in the developed world at least. Hence another research question:

- **Research Question: What assumptions about the nature of our modern information systems-supported world does computer art expose or illuminate?**

Of course, computer artists too follow fashions, conventions, and cultural norms. For example, Macintosh's graphical user interface (GUI) defined a particular aesthetic (based on straight lines, rectangular windows, etc.) which still dominates contemporary culture 20 years after its introduction (Manovich 2001a, p. 63). Some IS and HCI researchers have examined the role of culture in the design of products that are internationally available, such as websites (e.g., Marcus and Gould 2001). Interpretive IS researchers in particular have questioned the assumptions and cultural conventions incorporated into any IT-based system, not just those in a global marketplace. They could also examine the conventions of computer artists, leading to another research question:

- **Research Question: What cultural conventions and implicit assumptions can IS researchers discover in computer artists and their works?**

Barriers

Having outlined an agenda for IS research into computer art, this section reviews some of the potential barriers to the take-up of this agenda.

Bias to the Textual

It has been argued that there are multiple types of intelligence, and education tends to favor those with strong *linguistic intelligence*—the ability to use language effectively to express oneself rhetorically or poetically and as a means to remember information—over those with better *visual-spatial intelligence* or *musical intelligence* (Gardner 1993). Hence many IS researchers no doubt feel comfortable with the written word, and perhaps are less comfortable with the visual. Research supervisors, journal editors, conference organizers, and reviewers may need to recognize any bias toward the textual and accustom themselves to work that has a strong visual aspect alongside the textual.

Reluctance to Study Art Theory and History

IS researchers will also have to accustom themselves to a new “language” and set of theories, drawn from visual aesthetics and art criticism. Some may be reluctant to do this. However, IS is a multidisciplinary subject and has made use of theories from many other disciplines (e.g., psychology, sociology, and economics) so there should be no reason why it cannot also include the visual and computer art theories. As modern information systems increasingly require digital content creation as well as technical abilities, increasing numbers of IS developers are likely to come from computing departments with a strong computer art element. These are likely to appreciate the relevance of graphic design theory or the grammar of film. Also, IS researchers need not necessarily grapple with art theory; half the questions posed in this paper are concerned with applying *information systems theories* to digital art.

Challenge to Existing Modes of Thinking and Discourse

Many artists speak freely of their work in terms of love, emotion, and engagement. This is likely to cause problems for many researchers who have been trained to remove the subjective and “irrational” in their research. They will have to cope with new modes of thinking and discourse.

Artists naturally write in the first person about their research process. Many IS researchers, however, eschew such a style, and prefer the third person passive and an objective mode of writing. It is true that the need to write from a subjective viewpoint is recognized by IS researchers in the interpretive and critical research paradigms. However, these paradigms are not yet well-established in IS (Mingers 2003; Orlikowski and Baroudi 1991; Walsham 1995). Even IS researchers accustomed to confessional accounts may balk at the degree of self-revealing customarily displayed by artists.

Those IS researchers accustomed to concentrating on how information systems can make management more efficient, effective, or dominant will need to appreciate alternative IS research where business managers are not seen as the relevant focus. Similarly,

those focused on problem-solving and the development of bug-free systems will need to appreciate that others are focused on exploration, potential, and aesthetic criteria, where reliability and maintainability may be less important.

Rejection of Computer Art as an Information System

Finally some may reject the notion that computer art could be seen as a kind of information system. The whole research agenda outlined here rests on the assertion that it might usefully be seen in such a way. However, those rejecting the assertion must argue their position. I, in turn, will respond that, by forcing us to think about computer art and why it is *not* an information system, computer art has achieved one of its functions (theme 6 in the research agenda outlined here): forcing us to look at things anew, challenging our assumptions and conventions.

Conclusion

This paper has argued that computer art should be included within the scope of the IS discipline. It has proposed an agenda for IS research, based upon 6 themes in computer art and 12 questions. The link between IS and computer art is bidirectional: our theories of information systems could inform the study of computer art, and computer art could inform our information systems theories. As indicated in the "Introduction," some of the suggested avenues of research may turn out to be blind alleys leading nowhere, but some of them may lead to revised or new theories about the nature of information systems development and use. Some potential barriers to IS researchers investigating computer art have been identified, but they need not prevent such study.

It is hoped that the paper will broaden IS researchers' appreciation of the purpose and relevance of IS research and stimulate further research into computer art.

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